

GREEN FEED AS A SUPPLEMENT TO THE POULTRY DIET

by

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INTRODUCTION

Vitamin A is essential for promoting growth in young stock. Animals fed on an otherwise adequate ration but lacking in this vitamin cease to develop normally.

Plants synthesize a yellow pigment called carotene. Carotene is the precursor of vitamin A. It is present in the green parts of most green plants such as yellow corn and carrots. Birds change carotene into vitamin A in their livers. Hence birds may get their vitamin A supply from the carotene of plants or from fish oils in which vitamin A has already been converted by the fish from the carotene present in the sea plants. Hens store vitamin A in their livers and egg yolks. The amount stored in the egg yolk depends upon the quantity of carotene and vitamin A fed to the hen.

When vitamin A and carotene are exposed to the air, particularly at temperatures above 70°F. they become unstable, being readily oxidized. The vitamin A in fish oils is soon destroyed if exposed to the air any length of time. Carotene in plants such as alfalfa is fairly well preserved when the curing conditions are favorable; that is when the drying is accomplished rapidly but without prolonged exposure to sunlight, moisture, or to excessively high temperatures.

The purpose of this study was to investigate the differences in growth and reproduction resulting from birds having continuous green range and birds having no green range.

REVIEW OF LITERATURE

Reaumur (1750) observed that "the chickens run freely about our poultry yards, find grass there, they now and then eat it. They like grass and all green stuff that grows spontaneously but they like greens which are cultivated for ourselves. Lettuce, spinach, beets, cabbage furnish food for poultry. They eat less corn when full of vegetables." In short, he reported that green feed in the diet is absolutely indispensable to their health, and that the expense of their keeping will be diminished one-half by it. Moubray (1815) wrote that common trefoil, or wild clover, spurry or star grass were particularly solubrious to poultry. Again (1834) he mentioned that malted or sprouted barley and green cabbage leaves promote fecundity and great laying in the hen.

Green feed has been divided into the following subdivisions: fresh, leafy plants; silage; dehydrated products; alfalfa products; and "green buttermilk." The more commonly used fresh, leafy plants for poultry are Sudan grass, cereal grasses, vegetables, clover, and grass. Payne (1937) recommended that Sudan grass be planted on the range in rows 16-24 inches apart. The chicks have access to the green blades of grass and shade. Sudan grass grows rapidly and can be cut frequently. Oats is the most palatable of the cereal group. Oats can be cut once without destroying a grain crop. Carrick (1930) proved that sprouted oats were no more nutritious than dry oats,

but sprouting does make the grain more appetizing. Cabbage is used extensively as a winter green feed and has proved valuable as a vitamin A supplement. White clover is better than red clover because it is smaller and does not get woody. Fresh grass grazed or cut is excellent. Woodman (1928) concluded that grass should grow three weeks and then be grazed. He observed that the grass remained leafy which meant it was highly digestible. Payne and Gish¹ recommended oat plant silage as a reproduction of the "spring pasture." They reported a small percentage of dark egg yolks resulting from feeding silage. About four pounds of good quality grass silage daily per hundred hens was recommended. Dehydrated products are especially recommended as a source of vitamin A because, first, the meal is made at the time when the plants are most digestible and second, there is very little carotene lost while the meal is in cold storage. Green alfalfa, grazed or cut, fed fresh is a good vitamin A supplement. Alfalfa leaf meal is preferred to commercial alfalfa meal since it consists of about 85 per cent of the leaf particles, about 19 per cent crude protein, and about 18 per cent crude fiber. The carotene content of alfalfa is preserved when the curing process does not destroy the natural green color. "Green buttermilk", composed of fresh green grass pulp and condensed buttermilk, is recommended as a vitamin A supplement.

1. Unpublished data of Kans. Agr. Expt. Sta. 1940.

MATERIAL AND TECHNIQUE

Of the 800 birds used in this study, 400 were Barred Plymouth Rocks and 400 were Single Comb White Leghorns. The strain of Barred Plymouth Rocks was unknown. The Leghorns were from the Tom Barron strain. The flocks from which these chicks were hatched had been tested at least three times for pullorum disease with a period of six months between each test. The Barred Plymouth Rock chicks were hatched March 10, 1939 and the Leghorns April 18, 1939. The Plymouth Rocks were purchased from one of the better breeders in Texas. The Leghorns were hatched from the Prairie View State College flock, Prairie View, Texas where this work was conducted. They were from a mating of mature cockerels and hens in their second laying year. All chicks were wing-banded.

For the brooding, four plots were selected in a peach orchard that had not been used for chickens for seven years. The ground was plowed and then disked several times. Four 12'x 14' shed-roof colony houses were located on the plots. The yards were arranged so that each house had a run that was 60 feet wide (east and west) and 90 feet long (north and south). The houses were placed at the north end of the yards to make possible a southern exposure. Each brooder house was equipped with a 58" gas hover. The 400 chicks of each breed were divided equally between the grass and bare lots. Two Skinner irrigation lines

were used to obtain water to insure a constant supply of grass during the dry season.

Since green grass is more digestible just prior to the stage of growth at which lignification sets in, the Sudan grass and oats were grazed after growing three weeks. For the convenience of having grazing plots available and having green plots growing simultaneously, ten 20'x 30' frames were constructed. These frames were 12 inches high and covered with 1-inch mesh poultry netting. Five of these frames were used in each of the two green sections.

Two-hundred pounds of lime were applied to each plot before seeding to counteract the acidity of the soil. Fifty pounds of 8-4-4 commercial fertilizer were applied to each green feed plot at the beginning and for each successive seeding, five pounds were added to the 20'x 30' area. The fertilizer was deemed necessary because continuous irrigation without the addition of some plant food would deplete the soil. By planting one of the 20'x 30' plots each week, generous amounts of green vegetation was available. The seed would germinate and come up to a good stand in five to seven days. Therefore, 28 days were necessary to prepare each plot for grazing. The planting was done by breaking each plot with a small turning plow, broadcasting the seed by hand, and covering with a garden rake. In some of the plots equal amounts of Sudan and oats were mixed and sown, while other plots were seeded either to Sudan or oats. Irrigation was necessary from April throughout the growing period. A space of 12 inches along the fence that separated the green feed lot from

the bare lot was kept free of vegetation. The same was done along the outer fence in the bare lot section.

The brooder houses were thoroughly cleaned with boiling lye water before and after the stoves were installed. Sand was used for litter during the first eight weeks after which prairie hay was used.

The brooder stoves were operated for a period of eight hours prior to placing the chicks in the houses. A thermometer was suspended under the outer edge of the hover so that the bulb was two inches above the top of the sand. Guard boards placed around the canopy the first two days prevented the chicks from getting more than 18 inches away from the heat. The temperature under the hover was brought up to 95°F. and kept at that point for the first four days and then lowered gradually until the chicks could go safely without heat. The chicks in both lots were kept in the houses the first four days. On the fifth day they were allowed to run into a 10'x 10' yard. Once the birds got started on the yards, it was never necessary to confine them to the house again.

A commercial baby chick starting feed, sold by a reliable feed company, was used for the first 12 weeks. Feed was put into each house by the hundred pounds and the unconsumed portion weighed out at the end of each 4-week period. The mash mixture fed from 12 to 28 weeks of age is given below.

Yellow corn meal	100 lbs.
Wheat bran	100 lbs.
Wheat shorts	100 lbs.
Pulverized whole oats	100 lbs.
Meat scrap	75 lbs.
Sardine meal	25 lbs.
Alfalfa leaf meal (dehydrated)	50 lbs.
Salt	3 lbs.
Powdered limestone	4 lbs.
Total	<u>557 lbs.</u>

Grain fed:

Whole yellow corn	500 lbs.
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Both lots were fed mash and grain in separate hoppers ad libitum.

When the birds were 12 weeks old, different colored leg bands were put on the pullets on grass range and bare lots to identify birds that had gained access to the wrong yard.

Green feed was available for the birds from the beginning of the project until January 19, at which time low temperature killed the green vegetation.

From the green feed lots, there were 73 Rock pullets and 75 Leghorn pullets put into the laying quarters, and from the bare lots there were 69 Rocks and 71 Leghorns put into the laying quarters.

The calculated chemical analysis of the mash mixture showed 19.68 per cent protein, 3.56 per cent fat, 7.47 per cent fiber, and 45.50 per cent nitrogen free-extract. The combined mixture of mash and grain showed 14.73 per cent protein, 3.91 per cent fat, 4.81 per cent fiber, and 57.90 per cent nitrogen free-extract.

The birds were weighed and feed records were recorded at

four-week intervals. Group weights of chicks were taken on the fourth, twelfth, twentieth, and twenty-eighth weeks, and individual weights were recorded on the eighth, sixteenth, and twenty-fourth weeks. Table 1 records these data.

Table 1. The periods, dates, and kinds of weights taken.*
(Barred Rocks)

No. of period	Date of growing period	Date weights taken	Kind of weight
1	Mar. 11 to Apr. 7	4- 8	Group
2	Apr. 8 to May 5	5- 6	Individual
3	May 6 to June 2	6- 3	Group
4	June 3 to June 30	7- 1	Individual
5	July 1 to July 28	7-29	Group
6	July 28 to Aug. 25	8-26	Individual
7	Aug. 26 to Sept. 22	9-23	Group

*The same procedure was followed for Leghorns.

EXPERIMENTAL DATA

Growth

The size attained by chickens and the rate at which gains are made are determined by breeding, feeding, and management. Good feeding and management practices give the birds opportunity to develop to the maximum of hereditary possibilities. Card and Kirkpatrick (1918) developed a standard for food consumption and rate of growth in Leghorns and Rhode Island Reds for a period of 24 weeks. A part of their work is included in Table 2 for comparison with results obtained at Prairie View, Texas.

Table 2. Feed consumption and weight of chicks and pullets by 4-week intervals.

Connecticut ²				Texas			
				Av. wt.		Total feed	
				per chick		consumed	
Total feed :						per chick	
Age in	consumed	Av. wt.	Grass	Bare	Grass	Bare	
weeks	per chick	per chick	range	lot	range	lot	
Rhode Island Reds				Barred Plymouth Rocks			
0	0.00	0.08	0.08	0.08	0.08	0.00	0.00
4	0.95	0.36	0.50	0.43	1.08	1.06	
8	3.94	1.23	1.02	0.96	3.22	3.23	
12*	8.39	2.29	2.10	1.88	5.36	5.40	
16	13.58	2.91	2.81	2.66	6.29	6.46	
20	20.12	3.68	3.46	3.36	7.16	7.51	
24	27.24	4.29	4.15	4.03	7.75	7.78	
28	--	--	4.97	4.86	8.02	8.18	
White Leghorns							
0	0.00	0.08	0.08	0.08	0.08	0.00	0.00
4	0.94	0.38	0.33	0.32	0.95	0.99	
8	3.51	1.09	1.04	0.99	2.61	2.71	
12*	7.53	1.80	1.92	1.82	4.25	4.37	
16	12.11	2.36	2.02	1.89	4.69	5.12	
20	17.91	2.90	2.70	2.36	5.36	5.88	
24	23.84	3.28	3.54	2.87	5.90	6.29	

² Taken from Conn. (Storrs) Agr. Expt. Sta. Bul. 96, June 1918.

* Cockerels removed at end of 12th week.

Feed consumption and growth. The quantity of feed consumed by growing chickens is influenced by several factors, but the growth obtained is related to the feed intake. The data in Table 2 present the feed intake and growth secured in the stock used in this study.

For the entire growing period, the Barred Plymouth Rocks on grass range consumed 38.88 pounds of feed per bird and had an

average weight of 4.97 pounds. The controls on bare lot consumed a total of 39.62 pounds of feed per bird for an average weight of 4.86 pounds. The Leghorns on grass range consumed 23.76 pounds of feed per bird for an average weight of 3.54 pounds. The Leghorns on bare lot consumed a total of 25.36 pounds of feed per bird for an average weight of 2.87 pounds. Table 3 shows the pounds of feed required for each pound of gain. With the Barred Plymouth Rocks, the differences in feed consumed per pound of

Table 3. Feed consumption per pound gain and cost at 4-week intervals in Barred Plymouth Rock and White Leghorn chickens with and without grass range.

Age in weeks	Amount of feed, pounds		Cost of feed, cents	
	Grass range	Bare lot	Grass range	Bare lot
Barred Plymouth Rocks				
0-4	2.16	2.46	4.7	5.3
5-8	6.19	6.09	13.5	13.2
9-12	4.19	5.76	10.8	12.4
13-16	8.85	8.28	15.0	14.0
17-20	11.01	10.72	18.7	18.2
21-24	11.23	11.61	19.0	19.7
25-28	9.78	9.85	16.6	16.7
Total	53.41	54.77	97.68	99.50
Average	7.63	7.82	13.97	14.21
White Leghorns				
0-4	2.87	3.09	6.2	6.7
5-8	3.67	4.04	8.0	8.8
9-12	4.79	5.09	10.4	11.0
13-16	4.69	7.31	7.9	12.4
17-20	7.88	12.72	13.4	21.6
21-24	7.01	12.34	11.9	20.9
Total	30.91	44.59	57.80	81.40
Average	5.15	7.43	9.63	13.57

gain are in favor of the birds on grass range. On the eighth, sixteenth, and twentieth weeks the birds on bare lot showed a slight advantage over the birds on grass range. The Leghorns on grass range attained better gains than the bare lot Leghorns.

Mash hoppers were kept on the range, therefore, high winds caused some waste of feed.

Statistical treatment of growth data. Statistical treatment was made of the data on weight at 8 and 24 weeks of age. The probable error of the mean weights for both the grass and the bare lot groups was calculated. From these values, the probable error of the difference was obtained and compared with the actual differences between the groups.

The Barred Plymouth Rocks in the green lot group had a mean weight of .996 pounds and the bare lot group .936 at 8 weeks of age. The difference in weight of .060 with a probable error of the difference of .021 is too slight to have statistical significance.

The White Leghorns at the same age had a mean weight of .972 and .922 pounds on the green and bare lots, respectively. The difference of .050 pounds in favor of the green lot group is also not statistically significant since the probable error of the difference is .018.

At 24 weeks of age the Barred Plymouth Rocks on the green lot had a mean weight of 4.178 pounds and those on the bare lot, 4.089 pounds. The difference of .089 in favor of the green lot group when compared with the probable error of the difference of .057 is not significant.

The White Leghorns at 24 weeks of age had a mean weight of 2.983 pounds in the green lot group and 2.850 pounds in the bare lot group. The difference of .133 is just over four times its possible error of the difference of .029 and may be considered as statistically significant.

Egg Production

In order that the pullets would not be too crowded, increased laying quarters were provided the first week in September. The Barred Plymouth Rock pullets on bare lot were put into a 20'x 20' laying house but continued on a 60'x 90' bare lot. One-half of the Rock pullets on grass range were then transferred to the house formerly occupied by the bare lot birds.

The Leghorns on bare lot were put into two houses provided for them but continued on bare lot. The Leghorns on grass range were given a house and yard where they continued to receive green feed. The average number of birds per month together with the number of eggs produced by each group is given in Table 4.

A Barred Plymouth Rock on green range laid its first egg when 192 days old while the corresponding birds on bare lot laid their first egg when 209 days old. There was a difference of 17 days between first eggs. By the first of November the Rock pullets on grass range were laying at the rate of 11 per cent. Those in the bare lot for the same date were laying at the rate of 5 per cent. However, during November and December, production in both groups increased rapidly. Production in the grass range

Table 4. Average number of birds, number and percentage of eggs laid for Plymouth Rock and Leghorn pullets with and without grass range.

Month	Av. No. birds		Egg production		Percentage production	
	Grass range	Bare lot	Grass range	Bare lot	Grass range	Bare lot
Barred Plymouth Rocks						
Oct.*	73.00	68.26	348	72	11.32	5.04
Nov.	71.74	66.27	859	352	39.90	17.65
Dec.	70.77	65.00	1049	841	49.40	45.50
Jan.	69.90	63.74	1156	1032	55.10	54.00
Feb.	67.83	60.17	904	812	44.40	44.90
Mar.	65.81	56.94	1114	985	56.41	57.30
Apr.	61.90	55.10	1088	940	58.00	56.70
Total	553.95	504.48	6524	5034	314.53	281.09
Average	69.24	63.06	890.04	719.14	44.93	40.15
White Leghorns						
Oct.	74.11	71.00	431	22	20.28	00.15
Nov.	73.00	71.00	767	302	35.02	14.10
Dec.	73.00	70.00	884	645	40.36	27.70
Jan.	70.77	67.61	860	717	42.55	34.11
Feb.	60.00	63.00	827	764	45.94	41.26
Mar.	60.00	63.00	962	889	53.40	47.03
Apr.	60.00	63.00	1089	955	60.50	50.52
Total	545.77	539.61	5825	4294	298.05	214.87
Average	68.22	67.45	776.6	613.42	42.57	30.69

*The grass range Rocks laid 6 eggs in September and the grass range Leghorns laid 5 eggs.

group by January 1 was 49.40 per cent, and 44.90 per cent in the bare lot group. Production during February and March was slightly better in the bare lot pens than in the grass range pen. There was very little difference in production on May 1 as was

shown by the percentages 58.60 and 56.70 grass range and bare lot respectively. The average percentage for the laying period was as follows: Barred Rocks on grass range 44.93 and bare lot, 40.15.

The Leghorns on grass range were 146 days old when the first egg was laid, as compared with 171 days for the bare lot fowls. There was a difference of 25 days between first eggs. Production on November 1 for the Leghorns on grass range was 35.02 per cent against 14.10 per cent for the bare lot group. A comparison of percentages January 1 showed a difference of 12.66 per cent in favor of the grass range birds. The grass range group was laying 60.50 per cent on May 1, while the bare lot birds were laying 50.52 per cent. The average production for the entire laying period was 42.57 per cent for the grass range pullets and 30.69 per cent for the bare lot pullets.

Feed consumption and egg production. The feed consumption per bird is based upon the average number of birds for each period. The mash and grain were fed in hoppers. In all lots, the birds consumed more mash than they did grain. The mash was home mixed. A record of mash and grain consumed and the amount of feed consumed per bird is given in Table 5.

The average feed consumption per pullet per month in both lots of Barred Rocks was about the same. The total consumption was 56.24 pounds and 58.46 pounds or a monthly average of 8.03 pounds and 8.35 pounds grass range and bare lot respectively. The total feed consumption for Leghorns was 48.15 pounds for those on grass range and 48.79 pounds for those on bare lot, or a

Table 5. Total mash and grain consumed and feed per bird for Plymouth Rock and Leghorn pullets with and without grass range.

	:Pounds of :mash consumed :per month	:Pounds of :grain consumed :per month	:Pounds of :feed consumed :per month	:Pounds of feed :consumed per :bird per month
Month:	Grass : Bare : range : lot	Grass : Bare : range : lot	Grass : Bare : range : lot	Grass : Bare : range : lot
Barred Plymouth Rocks				
Oct.	:292.25 :300.00	:314.00 :308.00	:606.25 :608.00	: 8.31 : 8.57
Nov.	:299.00 :279.00	:277.00 :268.00	:576.00 :545.00	: 8.03 : 8.22
Dec.	:288.75 :280.00	:280.25 :261.75	:569.00 :541.75	: 8.03 : 8.30
Jan.	:279.00 :273.00	:272.50 :260.00	:551.50 :533.00	: 7.91 : 8.36
Feb.	:263.00 :257.00	:254.00 :254.00	:517.00 :511.00	: 7.53 : 8.32
Mar.	:302.00 :244.00	:287.00 :232.00	:589.00 :476.00	: 8.07 : 8.36
Apr.	:286.25 :231.00	:267.25 :228.00	:553.50 :459.00	: 8.36 : 8.33
Total:	2010 : 1864	1952 : 1811.75	3961.75 : 3673.75	56.24 : 58.46
White Leghorns				
Oct.	:234.00 :230.00	:225.00 :219.00	:459.00 :449.00	: 6.19 : 6.34
Nov.	:244.00 :239.00	:224.00 :221.00	:468.00 :460.00	: 6.41 : 6.48
Dec.	:253.00 :249.00	:228.00 :241.00	:481.00 :488.00	: 6.59 : 6.97
Jan.	:237.00 :241.00	:226.00 :238.00	:463.00 :479.00	: 6.54 : 7.08
Feb.	:217.00 :239.50	:191.00 :219.50	:408.00 :459.00	: 6.80 : 7.28
Mar.	:224.00 :238.00	:236.00 :222.00	:460.00 :460.00	: 7.66 : 7.30
Apr.	:241.00 :241.00	:237.00 :212.00	:478.00 :463.00	: 7.96 : 7.34
Total:	1650 : 1675.50	1567 : 1572.50	3217 : 3258	48.15 : 48.79

monthly average of 6.88 pounds and 6.97 pounds in the order named.

The amount of feed consumed per dozen eggs produced for each lot is given in Table 6.

The figures in Table 6 show the average eggs per hen per month and the average number of pounds of feed per dozen eggs

Table 6. Pounds of feed consumed per dozen eggs produced, based on average egg production per bird for Barred Plymouth Rock and Leghorn pullets with and without grass range.

Month	Av. production		Av. No. pounds		Av. No. pounds	
	per bird		feed per bird		feed per dozen	
	Grass	Bare	Grass	Bare	Grass	Bare
	range	lot	range	lot	range	lot
Barred Plymouth Rocks						
Oct.	4.63	1.03	8.31	8.97	21.58	104.33
Nov.	11.97	5.31	8.03	8.22	8.54	18.59
Dec.	14.80	11.40	8.03	8.33	6.53	8.76
Jan.	16.52	16.19	7.91	8.36	5.77	6.19
Feb.	13.33	13.49	7.53	8.32	6.78	7.49
Mar.	16.90	17.30	8.07	8.36	5.72	5.90
Apr.	15.57	17.06	8.36	8.33	6.44	5.87
Average	13.38	11.68	8.03	8.35	8.76	22.45
White Leghorns						
Oct.	5.81	0.31	6.19	6.34	12.79	244.00
Nov.	10.52	4.25	6.41	6.48	7.31	18.31
Dec.	12.54	9.92	6.59	6.97	6.30	9.07
Jan.	12.15	10.60	6.54	7.08	6.45	8.02
Feb.	13.78	12.13	6.80	7.28	5.91	7.21
Mar.	16.03	14.58	7.66	7.30	5.73	6.01
Apr.	18.15	15.16	7.96	7.34	5.27	5.82
Average	12.71	9.42	6.88	6.97	7.11	42.63

for Plymouth Rock and Leghorn pullets with and without grass range. Both the Rocks and the Leghorns on grass range show less feed per dozen eggs laid than do the corresponding birds on bare lot. The results in Table 6 agree with those obtained by Waite (1934) in that the higher the egg production, the greater the feed consumption per bird, but the fewer pounds of feed required

to produce a dozen eggs. The amount of feed consumed per dozen eggs during October was high due to low average production. The two bare lots were extremely high since the birds did not come in to production as uniformly as did the grass range birds. If the months from November through April are compared, the differences are not so great. The average number of pounds of feed per dozen eggs produced in the green feed lots approximate the results obtained by Waite in 1934. When the feed record for October is left out of the general average, the bare lot birds show an average more in keeping with the expected feed consumption per dozen eggs produced.

The amount and cost of feed required to produce a dozen eggs is given in Table 7.

Feed cost and egg production. There are several factors that enter into the cost of feed. Some of the factors are quality of ingredients, quantity and quality of animal-protein concentrates, vitamin D concentrates, distribution charges, and labor. Good feeds of superior quality in the same locality usually have the same average price range. Animal protein concentrates should be selected on the basis of their protein analysis, freedom from foreign material, and desirability in the particular ration. Reliability of the feed company is some help in purchasing feeds. The egg production depends upon the amount of feed, particularly mash, consumed by the birds. The amount of feed consumed depends upon palatability. It is brought out in these data that as the egg production increases, the cost per dozen eggs decreases. The birds on grass range produced eggs at

Table 7. Average number pounds of feed per dozen eggs, cost of feed per dozen eggs, and price received per dozen eggs.

	Pounds of feed		Cost of feed		Price received
	per dozen eggs		per dozen eggs		per dozen eggs
	Grass	Bare	Grass	Bare	
Month	range	lot	range	lot	
Barred Plymouth Rocks					
Oct.	21.58	104.33	37¢	\$1.77	23¢
Nov.	8.54	18.59	14.52	.316	25
Dec.	6.53	8.76	11.1	.1887	32
Jan.	5.77	6.19	9.81	.1668	30
Feb.	6.78	7.49	11.52	.1958	24
Mar.	5.72	5.90	9.72	.1652	20
Apr.	6.44	5.87	10.95	.1861	15
Average:	8.76	22.45	14.94	.3863	23.71
White Leghorns					
Oct.	12.79	244.0	21.74	4.15	20
Nov.	7.31	18.31	12.42	.3082	25
Dec.	6.30	9.07	10.71	.1541	32
Jan.	6.45	8.02	10.96	.1363	30
Feb.	5.91	7.21	10.04	.1225	24
Mar.	5.73	6.01	9.84	.1021	20
Apr.	5.27	5.82	8.96	.0989	15
Average:	7.11	42.63	12.09	.699	23.71

a lower cost than did the birds on bare lot. The Leghorns on green range produced the most economical eggs at 8.96 cents per dozen. Table 7 also shows the price paid for eggs at the local market. The feed cost per dozen eggs was excessively high in October and was attributed to very low egg production. Here again it can be stated that precocity was a prime factor in determining the cost of egg production. The birds on green range not only had persistency but the intensity as well, and the

health and vigor which is so necessary under these conditions to maintain high production over a long period of time. An examination of Table 7 will show that the bare lot birds produced expensive eggs and from this study, it would appear that the lack of precocity was a contributing factor. The birds of each group had the same breeding background, therefore, management practices influenced the time at which the pullets began laying.

Feed prices were obtained at a feed company in Houston, Texas, periodically on six occasions. These prices were used in calculating feed costs. The prices paid and dates same were obtained are reported in Table 8.

Table 8. Feed prices at Houston per 100 pounds at intervals during the experiment.

	1/24/39:	9/11/39:	11/20/39:	1/20/40:	4/11/40:	6/22/40:	Av.
Yellow corn meal	\$ 1.45	\$ 1.70	\$ 1.35	\$ 1.45	\$ 1.49	\$ 1.32	\$ 1.46
Wheat bran	1.19	1.40	1.15	1.19	1.33	0.99	1.28
Wheat shorts	1.40	1.65	1.45	1.40	1.49	1.39	1.46
Meat scrap 50% protein	3.00	2.75	3.25	3.00	3.00	3.00	3.00
Sardine meal 65% protein	3.10	2.85	3.00	3.00	2.90	3.00	2.97
Pulverized whole oats	1.75	1.95	1.75	1.75	1.85	1.75	1.80
Fine salt	1.30	1.30	1.30	1.30	1.30	--	1.30
Oyster shell	0.45	0.45	0.45	0.45	0.45	--	0.45
Alfalfa leaf meal (dehydrated)	2.25	2.25	2.25	2.25	2.25	--	2.25
Baby chick starter	2.50	2.65	2.50	2.50	2.45	2.50	2.52
Baby chick grain	1.85	1.85	1.85	--	--	--	1.85
Whole yellow corn							0.90

Hatchability

In order that full brother and sister matings could be avoided, male birds were selected from the Prairie View College Poultry Farm. Six Plymouth Rock cockerels were placed in each of the Rock pens and five Leghorn cockerels in each of the Leghorn pens. The mating pens were made up December 1, 1939. There were 1688 eggs set from each of the four groups. During the incubation period, eggs were gathered twice daily. They were held at a temperature between 55 and 60 degrees Fahrenheit for seven days. Eggs undesirable for hatching such as thin shells, tinted shells, cracked or dirty shells, misshapen, undersized, and oversized were not set. Settings were made at weekly intervals and the same number of eggs from each of the four lots was put into the machine at each setting. All eggs set weighed not less than 22 ounces per dozen. The data in Tables 9, 10, 11, and 12 show the date of each setting and the incubation record.

The eggs from the green feed lots hatched better than the eggs from the bare lots. Of the fertile eggs set from the Plymouth Rocks on green feed, 87.11 per cent hatched and 83.30 per cent of the fertile eggs set hatched from the Rocks on bare lot. Fertile eggs from the Leghorns on grass range hatched 89.45 per cent and the fertile eggs from the Leghorns on bare lot hatched 88.65 per cent. There was no apparent physical difference in the chicks hatched from any of the groups. A point for comparison is that eggs unhatched, chicks too weak to live, and chicks dead in

Table 9. Incubation record of eggs hatched from Barred
Plymouth Rock pullets on grass range.

Date hatched	Number eggs set	Number infertile	Number failing to hatch*	Number hatched	Percentage hatch of fertile eggs set
Jan. 4, 1940	96	23	13	60	82.10
Jan. 11	128	37	8	83	91.21
Jan. 18	131	32	10	89	89.89
Jan. 25	110	24	24	62	72.10
Feb. 1	96	27	18	51	73.91
Feb. 8	85	20	16	49	75.38
Feb. 15	96	30	7	59	89.59
Feb. 22	118	32	9	77	89.83
Feb. 29	124	30	11	83	88.29
Mar. 7	133	31	11	91	89.21
Mar. 14	154	29	12	113	90.40
Mar. 21	109	22	9	78	89.65
Mar. 28	116	22	7	87	92.55
Apr. 4	96	19	6	71	92.20
Apr. 11	96	22	5	69	93.24
Total	1688	400	166	1122	
Average	105.5	25	10.37	70.12	87.11

*Included in this column are eggs unhatched, chicks too weak to live, and chicks dead in the shell.

Table 10. Incubation record of eggs hatched from Barred
Plymouth Rock pullets on bare lot.

Date hatched	Number eggs set	Number infertile	Number failing to hatch	Number hatched	Percentage hatch of fertile eggs set
Jan. 4, 1940	96	27	12	57	82.61
Jan. 11	128	33	19	76	80.00
Jan. 18	131	30	16	85	84.16
Jan. 25	110	31	14	65	82.27
Feb. 1	96	29	23	44	65.67
Feb. 8	85	27	18	40	68.96
Feb. 15	96	30	18	48	72.72
Feb. 22	118	40	17	61	78.20
Feb. 29	124	39	14	71	83.53
Mar. 7	133	29	20	84	80.77
Mar. 14	184	33	11	110	90.90
Mar. 21	109	22	11	76	87.35
Mar. 28	116	21	6	89	93.68
Apr. 4	96	19	7	70	90.90
Apr. 11	96	20	4	72	94.73
Total	1688	430	210	1048	
Average	105.5	26.87	13.12	65.5	83.30

Table 11. Incubation record of eggs hatched from White Leghorn pullets on grass range.

Date hatched	Number eggs set	Number infertile	Number failing to hatch	Number hatched	Percentage hatch of fertile eggs set
Jan. 4, 1940	96	19	8	69	89.61
Jan. 11	128	29	8	91	91.91
Jan. 18	131	25	12	94	88.67
Jan. 25	110	28	9	73	89.02
Feb. 1	96	23	13	60	82.19
Feb. 8	85	20	11	54	83.07
Feb. 15	96	25	9	62	87.32
Feb. 22	118	27	8	83	91.21
Feb. 29	124	25	10	89	89.89
Mar. 7	133	20	12	101	89.38
Mar. 14	154	21	14	119	89.47
Mar. 21	109	15	7	87	92.55
Mar. 28	116	14	9	93	91.17
Apr. 4	96	14	6	76	92.68
Apr. 11	96	17	8	71	89.87
Total	1688	322	144	1222	
Average	105.5	20.12	9.00	76.37	89.45

Table 12. Incubation record of eggs hatched from White Leghorn pullets on bare lot.

Date hatched	: : Number : eggs set	: : Number : infertile	: : Number : failing : to hatch	: : Number : hatched	: : Percentage : hatch of : fertile : eggs set
Jan. 4, 1940	: 96	: 19	: 10	: 67	: 87.01
Jan. 11	: 128	: 27	: 12	: 89	: 88.11
Jan. 18	: 131	: 34	: 9	: 88	: 90.72
Jan. 25	: 110	: 27	: 9	: 74	: 89.15
Feb. 1	: 96	: 21	: 14	: 61	: 81.33
Feb. 8	: 85	: 19	: 16	: 50	: 75.75
Feb. 15	: 96	: 27	: 14	: 55	: 79.71
Feb. 22	: 118	: 31	: 16	: 71	: 81.60
Feb. 29	: 124	: 29	: 8	: 87	: 91.57
Mar. 7	: 133	: 24	: 7	: 102	: 93.57
Mar. 14	: 154	: 29	: 11	: 114	: 91.20
Mar. 21	: 109	: 15	: 7	: 87	: 92.55
Mar. 28	: 116	: 14	: 8	: 94	: 92.15
Apr. 4	: 96	: 15	: 9	: 72	: 88.88
Apr. 11	: 96	: 17	: 9	: 70	: 88.60
Total	: 1688	: 348	: 159	: 1181	:
Average	: 105.5	: 21.75	: 9.93	: 73.75	: 88.65

the shell ran a little higher in the bare lots than in the grass lots. The percentages are as follows: Rocks on grass range 14.8, Rocks on bare lot 20.00, Leghorns on grass range 11.8, and Leghorns on bare lot 13.4.

Mortality

There is no standard for normal mortality. Voorhies and Read (1931) suggested that baby chicks have approximately 920 chances out of a thousand of reaching the fifteenth day of the brooding period. Charles and Stuart (1934) offered the following rearing expectancy:

Mortality first three weeks 2-15 per cent
Mortality after first three weeks to maturity 2-10 per cent

Table 13 gives a record of the mortality at four-week intervals for 28 weeks in Rocks and 24 weeks in Leghorns.

In the Barred Rocks on grass range there was a total of 24 deaths during the growing period, 45.83 per cent of which occurred prior to the fifteenth day. Similarly the Rocks on bare lot had a total mortality of 47 during the growing period and 37.50 per cent occurred before the fifteenth day. Of the total mortality, 59 per cent occurred during the first four weeks in each of the Barred Plymouth Rock lots.

The mortality in the Leghorn lots was lower than the mortality in the Rock pens. There were 12 deaths among the Leghorns on grass range, 41.66 per cent of which occurred before the fifteenth day, and all prior to the twelfth week. The Leghorns on

Table 13. Mortality record to 28 weeks for Plymouth Rock and White Leghorn chickens with and without grass range.

Age in weeks	No. birds		Mortality		Av. No. birds	
	Grass range	Bare lot	Grass range	Bare lot	Grass range	Bare lot
Barred Plymouth Rocks						
0-4	200	200	14	28	191.86	185.60
5-8	186	172	6	7	183.50	168.65
9-12	77	81	2	3	76.03	78.97
13-16	75	78	0	3	75.00	76.29
17-20	75	75	1	3	74.15	73.11
21-24	74	72	0	2	74.00	70.75
25-28	74	70	1	1	73.67	69.28
White Leghorns						
0-4	200	200	6	7	196.82	196.75
5-8	194	193	4	7	193.93	190.04
9-12	77	82	2	8	75.89	77.68
13-16	75	74	0	3	75.00	72.22
17-20	75	71	0	0	75.00	71.00
21-24	75	71	0	0	75.00	71.00
	:	:	:	:	:	:

bare lot had a total of 25 deaths and 12 per cent before the fifteenth day. The mortality among the pullets in all groups was very low. There was unusually cold weather during the latter part of January which caused several frozen combs. A few of the birds died immediately after the sudden change in the weather. The mortality among the pullets is given in Table 14.

Table 14. Mortality record of Plymouth Rock and White Leghorn pullets in laying houses with and without grass range.

Month	No. birds		No. died		No. culled	
	Grass range	Bare lot	Grass range	Bare lot	Grass range	Bare lot
Barred Plymouth Rocks						
Sept.	73	69	0	0	0	0
Oct.	73	69	0	0	0	0
Nov.	73	68	1	2	1	1
Dec.	71	65	1	0	0	0
Jan.	70	65	0	2	1	1
Feb.	69	62	1	2	1	1
Mar.	67	59	1	1	1	2
Apr.	65	56	2	1	3	0
White Leghorns						
Sept.	75	71	0	0	0	0
Oct.	75	71	1	1	1	0
Nov.	73	71	0	0	0	0
Dec.	73	71	0	1	0	1
Jan.	73	69	0	2	13	4
Feb.	60	63	0	0	0	0
Mar.	60	63	0	0	0	0
Apr.	60	63	0	0	0	0

DISCUSSION

The use of a grass range for the growth and reproduction of poultry proved to be more valuable in this study than did the use of a bare lot. The differences were not sufficient in all instances to be significant.

The appearance of the birds on grass range was typical of vigorous and healthy chickens. Yellow pigment could be observed

readily by any interested person. The shanks and beaks of the Leghorns on grass range contained as much pigment as is usually desirable. The birds on bare lot were pigmented but not as much as the grass range birds. A large number of the cockerels raised on grass range was sold as breeders to farmers at a price of three dollars each. Pullets grown on green range went into production without a single bird molting, whereas the Leghorns on bare lot suffered from colds between the 20th and 24th weeks after which about 50 per cent of the bare lot Leghorns molted. The Rocks on bare lot did not molt.

The growth rate in both lots of Rocks was not as good as that secured for Rhode Island Reds at the Connecticut Station in 1918. The Leghorns on grass range showed slightly better gains. Better gains doubtless could have been secured with a higher percentage of protein. Broilers are being produced to weigh two pounds in eight weeks on an 18 per cent protein diet. Pullets reared on a ration containing 18 per cent protein would probably begin laying before sufficient body weight was attained to sustain heavy production through the winter. In the Rocks, the amount of feed consumed per pound gained was about the same for both lots. The Leghorns showed a difference. The average feed intake per pound gained in the grass range Leghorns was 5.15 pounds, while the bare lot Leghorns consumed 7.43 pounds per pound gained. Cost of feed per pound gained obviously varies with the intake.

Except for the Leghorns on bare lot, all the pullets had excellent handling qualities. They were of the aggressive type.

The eggs at the beginning of the laying period were sold as "pullet eggs." However, by the 15th of November a large percentage of the eggs produced by the pullets on grass range was of sufficient size to be sold along with eggs from hens. It was the middle of December before a large number of the eggs produced by the pullets on bare lot could be marketed with the other eggs. A few of the eggs from each group were broken to observe the yolk color. Some of the egg yolks from the grass range birds appeared to be of a darker yellow than the yolks from the bare lot birds. When a larger number of eggs were broken, it was concluded that the yolks did not vary in color any more than is found in individual hens.

It is possible that the green range supplied the vitamin A necessary to account for the differences in hatchability, viable embryos, weak chicks, and chicks too weak to hatch.

For convenience of comparison, the mortality record was divided into three periods. First, brooding (0-8 weeks); second, rearing (9-28 weeks for Rocks and 9-24 weeks for Leghorns); and third, pullet (29-61 weeks). For the brooding and rearing mortality in the grass range Rocks, 83.3 per cent occurred during the brooding period and 16.6 per cent during the rearing period. The grass range Leghorns were the same as the Rocks on green range, but the bare lot Leghorns had 56 per cent of the mortality during the brooding season and 44 per cent during the rearing period. The pullet mortality in the Rocks was higher than that of the Leghorns. The grass range Rocks had 8.2 per cent, bare lot Rocks 11.6 per cent, while the grass range Leghorns had 1.33 per cent, and the bare lot Leghorns 5.63 per cent.

SUMMARY

1. A study of grass range versus bare lot for fowls was made upon 800 chickens, 400 of which were Barred Plymouth Rocks and 400 White Leghorns.

2. In the study, the White Leghorns grown on an adequate diet with grass range consumed less feed per pound gained than birds grown on the same ration but without grass range. There was a difference of .133 pound in favor of the Leghorns on green range which was statistically significant. The Barred Plymouth Rocks on grass range showed a difference of .089 over the bare lot birds, but this was not significant.

3. The grass range produced earlier laying in all pullets. The Barred Plymouth Rocks on the grass began laying 17 days earlier than the Barred Plymouth Rocks on bare lot, while the grass range Leghorns began laying 25 days earlier than the bare lot Leghorns.

4. The average number of eggs laid per bird on grass range was higher than that per bird on bare lot.

5. Hatchability was slightly higher for birds on green feed than for those on bare lot, but the difference was not significant.

6. The mortality was very low in all groups. The Barred Plymouth Rock pullets showed 8.2 and 11.6 per cent and the Leghorns 1.33 and 5.63 per cent for grass range and bare lot, respectively.

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